The genetic determinism of human performances. A comparison between teachers' conceptions in Finland and France

Jérémy Castéra, Pierre Clement

Castéra J. & **Clément P.,** 2009a - The genetic determinism of human performances. A comparison between teachers' conceptions in Finland and France. in M.F.Tasar & G.Cakmakci (eds), *Contemporary Science Education Research: International Perspectives.* (pp. 459-466), Ankara, Turkey: Pegem Akademi.

THE GENETIC DETERMINISM OF HUMAN PERFORMANCES. A COMPARISON BETWEEN TEACHERS' CONCEPTIONS IN FINLAND AND FRANCE.

Jérémy Castéra
LEPS-LIRDHIST, Université Lyon 1, France

Pierre Clément
Honorary from Université Lyon 1, France

Abstract

Finland has the best mean sciences scores among the OECD countries while France is in the OECD average (PISA 2006). Nevertheless, when measuring interactions between knowledge and values in teachers' conceptions, the comparison between the two countries shows surprising results.
In the context of the European research project Biohead-Citizen, in-service and pre-service teachers filled out a questionnaire including 31 questions related to the genetic determinism of human performances. The samples (732 in France, 306 in Finland) comprised Primary School teachers and Secondary School Biology and Language teachers.
The answers to the questions dealing with only scientific knowledge, or with only social values, did not differ with the country. Nevertheless, there are very significant differences for the interactions between knowledge and values mainly related to innatism: for instance, Finnish teachers more agree with the proposition "there are genetic factors in parents that predispose their children to be good in school" (or "good violinists"); or with "It is for biological reasons that women more often than men take care of housekeeping". Our results are analysed with different statistical tests including multivariate analyses. They are then discussed, taking into account the respective content of school textbooks in the two countries.

Key-words: Scientific knowledge, values, innatism, human genetics, teachers, Finland, France, PISA.

1. Introduction: biological and social context

The debate between nature and culture is outdated, both being necessarily in constant interaction (Atlan 1999, Jacquard & Kahn 2001, Kupiec & Sonigo 2001, Lewontin 2003). This interaction between the genome and its environment (called "epigenetics": Morange 2005) is a new paradigm in biology: is it introduced in the school curricula? The European research project BIOHEAD-Citizen (2004-2008) worked on this question, analysing the syllabuses and school textbooks in 19 countries, as well as the teachers' conceptions on this topic.

This is a "question vive" with an important social challenge. The philosopher Canguilhem (1981) defined the explanation of complex social features by only the human genes as an ideology inside Life Sciences. Some psychologists, Keller (2005) in Germany or Dambrun (2007) in France, focused the link between this ideology and intolerant attitudes as sexism or racism. Can we find some link between innatism, sexism and racism in teachers' conceptions?

While Simonneaux (1995), as well as Abou Tayeh & Clément (1999), showed that students' opinions are more difficult to change than their scientific knowledge, Kochkar (2007) showed that some knowledge about the cerebral epigenesis decreases the beliefs in innatism. Can we find a link between teachers' opinions and their scientific knowledge? To answer to this question, we decided to focus our analysis on two countries evaluated as very different by PISA (2006): Finland obtained the best sore on the scale of the *"scientific literacy"* and France obtained a score just under the OECD average. Concerning the topic "human genetics", and its possible link with ideologies as innatism, sexism or racism, are there differences among the French and Finnish teachers' conceptions?

The innatism is still present in the syllabuses and textbooks of the both countries: Castéra et al (2008) showed a great frequency of the words "genetic program" in French biology textbooks for student 14-16 years old and even more in Finnish biology textbooks for students 16-19 years old. What are the teachers' conceptions on innatism in these two countries?

Rationale: research questions

Are there differences among Finnish and French teachers related to scientific knowledge on human genetics as well as on cerebral epigenesis?

Are there differences among Finnish and French teachers related to ideologies as innatism, sexism or racism?

Are there interactions between scientific knowledge and values of Finnish and French teachers?

Methods

Questionnaire

The questionnaire included 31 questions dealing with the topic "human genetics". Some of them concerned sexist or racist positions, some others the innate determinism of human beings features, and the others the scientific knowledge related to human genetic and cerebral epigenesis. Most of the questions of our questionnaire are built to evaluate possible interaction between K and V (knowledge and values). The values are linked to the sexist ideology vs equality between men and women, to racist ideology when considering a "genetic superiority" of some ethnic groups, or only to the ideology of innatism, as the genetic determinism of human features or performances. The end of the questionnaire was related to personal characteristics of each responder (gender, age, religious or political opinions, etc.). The questionnaire has been built during 2 years, with a pilot test and other processes to select, to translate and to validate the questions (Clément & Carvalho 2007).

Samples

1038 teachers filled in the questionnaire in Finland (306) and in France (732). In each country, six categories of samples were defined in a well-balanced way: in-service teachers of primary schools (InP), in-service teachers of secondary schools in biology (InB) or in language (InL), pre-service teachers of primary (PreP) or secondary schools in biology (PreB) or in language (PreL).

Data analysis

Data from these questionnaires are handled by classical statistical analyses as well as by multivariate analyses (Principal Component Analysis, Between-analysis and Principal Component Analysis with respect to orthogonal Instrumental Variables). The measure of significance was done by Chi^2 test or by a Monte Carlos test from the between-class analyses (Munoz & Clément 2007; Munoz et al. 2009).

Results

The *Principal Component Analysis* shows strong inter-individuals differences mainly linked to the questions dealing with innatism (component 1) but also to some questions related to scientific knowledge (component 2). The orthogonality of the two components shows their relative independence.

A between-class analysis differentiating the six samples shows that the scientific knowledge differentiates biologists from other teachers in both countries, in the same way for each country.

The between analysis differentiating the two countries shows very clear differences among the teachers of the two countries (figure 1a), differences that are very significant (Monte Carlo test: figure 1b, $p < 0.0001$). In this analysis, the questions differentiating the most the two countries are listed in the table 1.

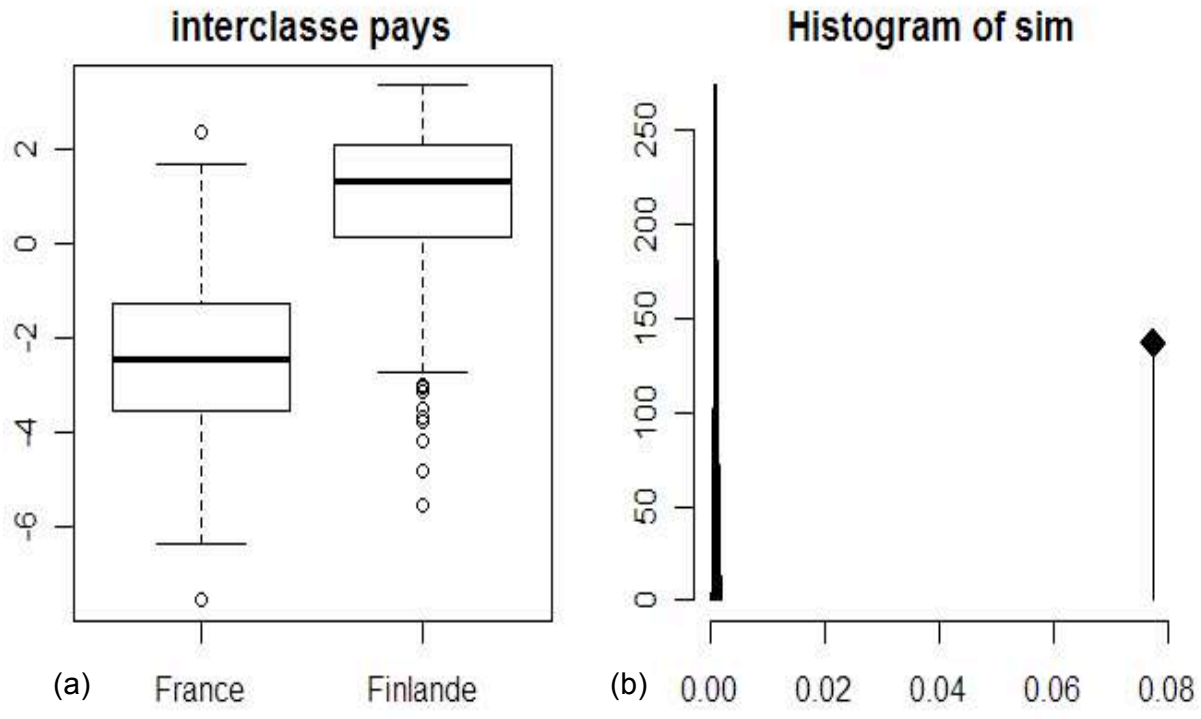

Figure 1 - Between analysis differentiating the French teachers' conceptions from the Finnish teachers' conceptions on genetic determinism. (a) - Each box inserts half of the values. The overlapping of the two countries is very reduced. **(b)** - Randomization test (Monte Carlo): the 1000 essays by chance (histogram at left) are very far from the observed value (at right). The difference between the two countries is very significant ($p < 0.0001$).

The question that has the most weight in this "effect country" is the question B10 (figure 2): *"There are genetic factors in parents that predispose their children to be good in school"*? Only 3% of Finnish teachers disagree (while 61% of French teachers do) ; 29% of Finnish teachers agree, 79% agree or rather agree (while only 3% and 18% of French teachers do). The difference between Finland and France is highly significant (Chi^2 test, p-value $< 2.2e^{-16}$).

The table 1 lists the 13 questions which significantly differentiate the Finnish and French teachers' conceptions. The less but significant difference is dealing with racism: B35 (figure 3): *"Ethnic groups are genetically different and that is why some are superior to others."* Only 78% of Finnish teachers disagree with this proposition, while 93% of French teachers do. The difference is clearly significant (Chi2 test after the Bonferroni's correction: p-value < 0.001).

Table 1 - **List of the 13 questions differentiating the Finnish and French teachers' conceptions** (from the between analysis presented in figure 1). For each question, it was a Likert' scale of 4 boxes, from "I agree" to "I don't agree". The figure 2 is illustrating the most important difference (B10) and the figure 3 the less but still significant difference (A35). (…) = The answers to the other 18 questions are not significantly differentiating Finnish and French teachers' conceptions.

	D1	
B10	- 0,62	There are genetic factors in parents that predispose their children to be good in school
B20	- 0,59	There are genetic factors in parents that predispose their children to become very good violinists
B4	- 0,57	Human social behaviour is partly directed by genes
B14	- 0,51	There are genetic factors in parents that predispose their children to be aggressive
A38	- 0,50	It is for biological reasons that women more often than men take care of housekeeping
A24	- 0,40	If clones of Mozart could be obtained, they all would be excellent musicians
A3	- 0,40	If clones of Einstein could be obtained, they all would be very intelligent
B11	- 0,36	There are genetic factors in parents that predispose their children to become homosexual
B8	- 0,35	There are genetic factors in parents that predispose their children to become alcoholics
A31	- 0,27	When a couple has already had two girls, the chances that their third child be a boy are higher
A36	- 0,21	Men might be more able to think logically than women, because men might have different brain bilateral symmetry
A35	- 0,17	Ethnic groups are genetically different and that is why some are superior to others
(…)	(…)	
A30	+ 0,20	It is important that there are as many women as men in parliaments

The answers to 18 questions, from the 31 ones related to the topic of biological determinism of human features or performances, don't differentiate Finnish from French teachers: the questions focused on only scientific knowledge (except A31: table 1); those related to identical twins and those related to interactions between scientific knowledge and values dealing with sexism or feminism., with the important exception of two of these questions (listed in the table 1): A38 ("*It is for biological reasons that women more often than men take care of housekeeping"*) and A36 *("Men might be more able to think logically than women, because men might have different brain bilateral symmetry").* The question A30, dealing with only social values (the number of women in the Parliament), is also significantly differentiating the Finnish and French teachers' conceptions.

The answers that differentiate the most Finnish from French teachers are linked to innatism. They are mainly dealing with the questions of the genetic factors of parents that predispose their children to be good at school (B10), or very good violinist (B20), or aggressive (B14), or homosexual (B11) or even alcoholic (B8). The Finnish teachers' answers could be a priori interpreted not as innatism, but as telling with the "genetic part" in the double determinism of these features or performances. The same argument could be proposed to interpret Finnish answers to the question B4 (table 1), more agreeing with the proposition: *"Human social behaviour is partly directed by genes"*. Nevertheless, the answers to the two questions related to clones (A24 and A3: table 1) clarify the innatism of many Finnish teachers. Considering that clones of Einstein (A3) or of Mozart (A24) would be very intelligent of excellent musicians is considering that these performances have a genetic support.

Finally, we can conclude that Finnish teachers are more innatist than French teachers. Is this innatism linked to other ideologies as sexism or racism? We saw in introduction that this link has been proved in some situations

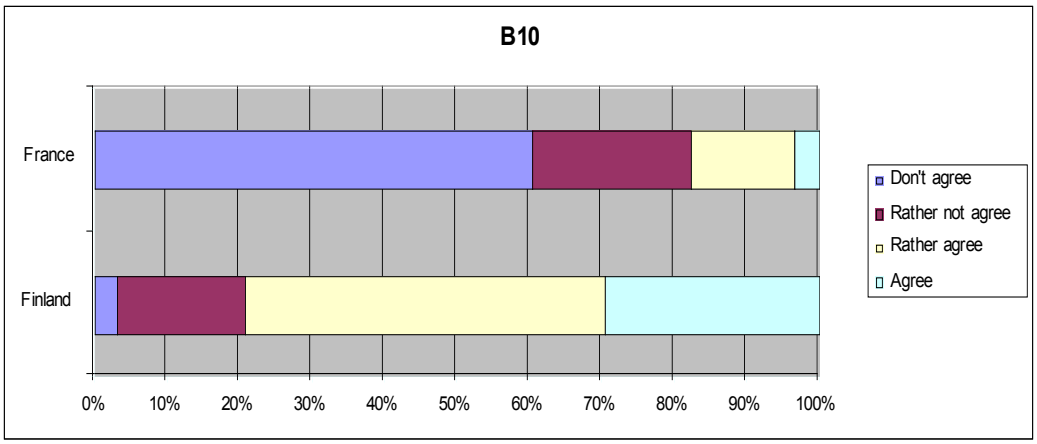

Figure 2 - Percentages of French and Finnish teachers' answers to the proposition B10: "*There are genetic factors in parents that predispose their children to be good in school"*

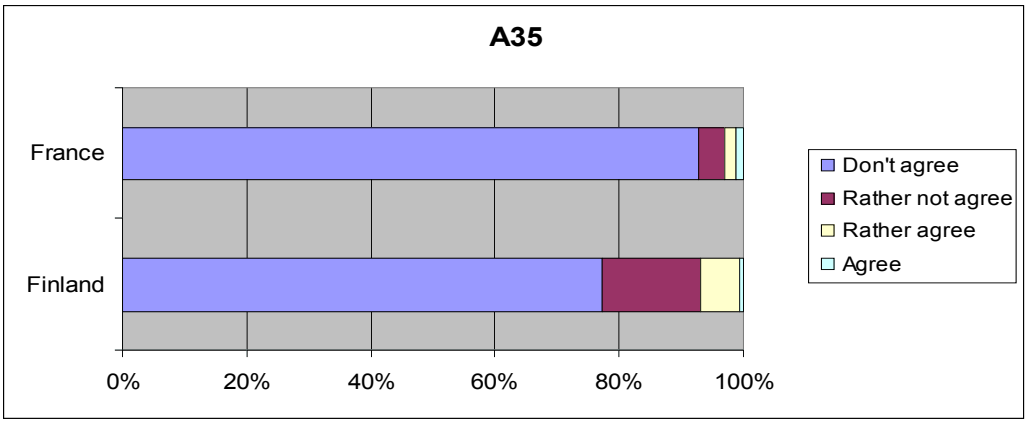

Figure 3 - Percentages of French and Finnish teachers' answers to the proposition A35: *"Ethnic groups are genetically different and that is why some are superior to others."*

(Keller, 2005 ; Dambrun 2007). Nevertheless: (i) the weight of these questions in the between analysis is clearly less important than the weight of the questions related to innatism (figure 1 and table 1) and (ii) for more questions related to feminist / sexist conceptions, there is no significant difference between the Finnish and French answers. This last point is less surprising considering the feminist reputation of Scandinavian countries, while the sexism of some Finnish teachers, expressed through their answers to 3 questions (A38, A36 and A30) is more surprising. It can be linked with the innatism of these teachers. In these cases, there is a clear interaction between K and V (scientific knowledge and values). This interaction has been found also among the scientists themselve, when the famous Journal Nature published a more ideological than scientific agenda concerning the cerebral lateralisation of men and women (Clément 2001, Vidal 2001).

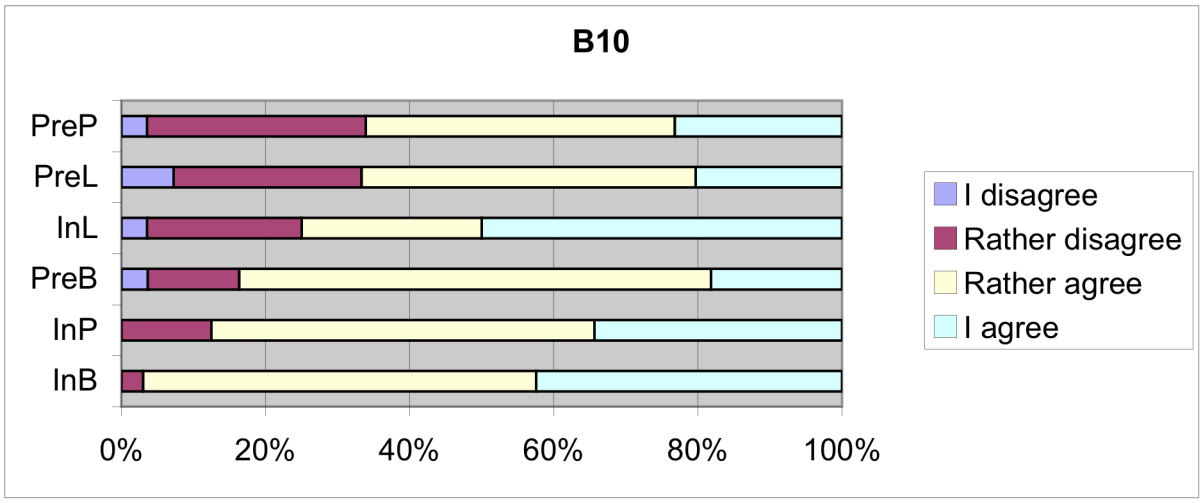

Figure 4 - Answers of the six Finnish sub-samples to the question B10 *"There are genetic factors in parents that predispose their children to be good in school"*. InB = in-service Biology teachers (secondary schools) ; InP = in-service Primary schools teachers ; PreB = pre-service biology teachers ; inL = in-service Language (Finnish) teachers (secondary schools) ; PreL = pre-service Language (Finnish) teachers ; PreP = pre-service Primary schools teachers.

An other analysis of our results shows that, in Finland, the biology teachers are more innatist than their non biologist colleagues. The figure 4 is illustrating this point from the answers to the question B10. This figure also shows that the innatism is stronger for in-service teachers than for the pre-service ones: this is a generation effect that we will describe more precisely in an other work. This complementary result suggest two conclusions: (i) the more important level of innatism in Finland could be linked to the way biology was taught and (ii) it could be also linked to the history of the country, more memorised by the oldest teachers.

Conclusions and Implications

In conclusion, the differences pointed by PISA (2006), related to the students' scientific literacy, are not linked, for this precise topic (biological determinism of human features and performances), with differences of teachers' knowledge. There is no significant difference between the Finnish and French answers for almost all the questions dealing with only scientific knowledge (related to human genetic and to cerebral epigenesis).

Nevertheless, there are important differences between Finnish and French answers related to the genetic determinism of human features, behaviour or performances. The convergence of answers from several kinds of questions related to this topic shows a clear innatism in a majority of Finnish teachers answers, and even more when they are biologist and in-service teachers. Moreover, this innatism is partly correlated to some sexist and even racist answers.

This conclusion is illustrating interactions between the taught science (the scientific knowledge K) and implicit values (V). It also shows that the indicators used by international surveys on the scientific literacy (as PISA 2006) are generally ignoring the values that can be linked to some scientific knowledge. Taking more into account these values

is an important challenge not only for the international evaluations, but also for the teachers training and the science teaching / learning.

Why these differences between Finland and France? The explanation is not so easy and must be object of more research. We can just propose some very hypothetical suggestions:

The biology syllabuses and textbooks are still teaching an implicit innatism in Finland with a great occurrence of the terms « genetic program » (Castéra *et al.* 2008). The researchers in biology are more and more claiming that the use of these two words is to be avoided, in the research as well as in the biology teaching (Atlan 1999, Jacquard & Kahn 2001). This change is just starting in the French syllabuses and textbooks (Forrissier & Clément 2003). The delay of this change (the DTD = Delay of the Didactic Transposition: Quessada & Clément 2007) is apparently longer in Finland, probably for socio-historical reasons that are still to be analysed.

France is the country of the Revolution, with an early separation between politics and religion (promotion of secular structures: « laïcité »). The history of Finland is very different.

The great debate between innate and/or acquired was very strong in the French media, the most famous French scientists and philosophers being against fatalism from a strong genetic determinism. It was possibly different in Finland?

In our samples, half of French teachers are agnostic or atheist when 2/3 of Finnish teachers are Protestant (Lutheran, when French Protestants are mainly Calvinist): are genes taking the relay of God in the determinism of human behaviour and performances?

Acknowledgements

This work has been supported by the European Research Project BIOHEAD-Citizen (Specific Targeted Research n° 506015, FP6, Priority 7: *"Biology, Health and Environmental Education for better Citizenship"*, 2004-2008). We particularly thank Anna Liisa Kosonen (Faculty of Education, University of Joensuu, Box-86, 57101-Savonlinna, Finland) who had an essential role in the translation of the questionnaire in Finnish and then in gathering the filled questionnaires from the precise six Finnish samples.

References

Abou Tayeh P. & Clément P. (1999). La Biologie entre opinions et connaissances : Les conceptions d'étudiants libanais sur le cerveau. in *L'actualité de la recherche en didactique des sciences et des techniques. Actes des Premières Rencontres scientifiques de l'ARDIST (Association pour la Recherche en Didactique des Sciences et des Techniques),* ENS Cachan, p.81- 87.

Atlan H. (1999) *La fin du "tout génétique"*. Paris: INRA.

BIOHEAD-Citizen Biology, Health and Environmental Education for better Citizenship (2004-2008) Coordinated by Carvalho G., Clément P., Bogner F. (FP6, Priority 7). http://projectos.iec.uminho.pt/projeuropa/ Retrieved 5 October 2009.

Canguilhem G. (1981) *Idéologie et rationalité dans l'histoire des sciences de la vie*. Paris: Vrin.

Castéra J., Clément P., Abrougui M., Nisiforou O., Valanides N., Sarapuu T., Turcinaciciene J., Agorram B., Calado F., Bogner F. & Carvalho G. (2008). Genetic determinism is school textbooks: a comparative study conducted among sixteen countries. *Science Education International*, 19, 2, 163-184.

Clément P. (2001). Using complex images in the popularization of science : Scientific or ideological agenda ? in *"Multimedia learning : cognitive and instructional issues",* Rouet J.F., Levonen J., Biardeau A., eds. London : Pergamon (Elsevier Science), p.87-98 (& p.182-183).

Clément P. (2004). Science et idéologie : exemples en didactique et épistémologie de la biologie. Actes du Colloque *Sciences, médias et société.* ENS-LSH, p.53-69 http://sciences-medias.ens-lsh.fr

Clément P. (2006). Didactic Transposition and the KVP Modèle: Conceptions as Interactions Between Scientific Knowledge, Values and Social Practices. *Proceedings Summer School ESERA*, IEC, Univ. Minho (Portugal), 9-18.

Clément P. & Carvalho G. (2007). Biology, Health and Environmental Education for better Citizenship: teachers' conceptions and textbook analysis in 19 countries. *WCCES XIII (World Council of Comparative Education Societies*, Sarajevo, CD-Rom, 15 pp.

Dambrun M., Kamiejski R., Haddadi N. & Duarte S. (2008). Why does social dominance orientation decrease with university exposure to the social sciences? The impact of institutional socialization and the mediating role of "geneticism". *European Journal of Social Psychology.* (Manuscript accepted).

Forissier T., Clément P. (2003). Teaching "biological identity" as genome / environmental interactions. *Journal of Biological Education,* 37, 2, 85-91

Jacquard A. & Kahn A. (2001) *L'avenir n'est pas écrit.* Paris: Bayard.

Keller J. (2005). In genes we trust: The biological component of psychological essentialism and its relationships to mechanisms of motivated social cognition. *Journal of Personality and Social Psychology*, 88, 686-702.

Kochkar M. (2007). *Les déterminismes biologiques. Analyse des conceptions et des changements conceptuels consécutifs à un enseignement sur l'épigenèse cérébrale chez des enseignants et des apprenants tunisiens.* Thèse Doctorat Université Lyon 1 & ISEFC, Université de Tunis.

Kupiec J.-J. & Sonigo P. (2000). *Ni Dieu, ni gène.* Paris : Seuil.

Lewontin R. C. (2003). *La triple hélice. Les gènes, l'organisme, l'environnement.* Paris: Edition du Seuil.

Morange M. (2005). Quelle place pour l'épigénétique? *Medecine Science*, 21, 367-369.

Munoz F. & Clément P., 2007 - Des méthodes statistiques originales pour analyser les conceptions d'enseignants de plusieurs pays à partir d'un questionnaire sur des questions vives. *Actes Colloque AREF (Actualité de la Recherche en Education et en Formation),* Strasbourg, 470 (12 pp.) : file:///Volumes/Actes%20AREF%202007/Actes.html

Munoz F., Bogner F., Clément P. & Carvalho G., 2009 - Teachers' conceptions of nature and environment in 16 countries. *Journal of Environmental Psychology.* in press. doi:10.1016/j.envp.2009.05.007

PISA. (2006) Learning for tomorrow's world. Paris: OECD.

Quessada M.P., Clément P., 2007 - An epistemological approach to French curricula on human origin during the 19th & 20th centuries. *Science & Education,* 16, 9-10, 991-1006.

Simonneaux L. (1995). *Les bio-technologies de la reproduction animale chez les bovins : approche didactique et muséologique*, Thèse de doctorat, Université Lyon 1.

Vidal C. (2001). Quand l'idéologie envahit la science du cerveau. *La Recherche*, hors-série 6, p.75-79.